

REMARKS

Applicant acknowledges receipt of the Examiner's Final Office Action dated March 17, 2006. This Office Action rejects all pending claims. In light of the following remarks, Applicant respectfully requests the Examiner's reconsideration.

Claims 1, 5-9, 32, and 36-37 stand rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 6,358,329 issued to Seiji Muranaka et al. ("Muranaka"). Applicant agrees that Muranaka is a very relevant prior art reference. While Muranaka is a highly relevant prior art reference, Applicant believes the claims are distinguishable as more fully described below.

Independent claim 1 recites:

A method comprising:
forming a tungsten plug in a dielectric layer;
forming an electrically conductive interconnect line
on the dielectric layer after formation of the
tungsten plug, wherein the tungsten plug is
electrically connected to the electrically
conductive interconnect line;
contacting the electrically conductive interconnect
line with liquid water after formation of the
electrically conductive interconnect line;
contacting the electrically conductive interconnect
line with a solution to remove residual
polymer after the electrically conductive
interconnect line is contacted with the liquid
water;
wherein the electrically conductive interconnect line
is contacted with the liquid water for less
than 120 minutes.

Claim 1 requires contacting the electrically conductive interconnect line with a solution to remove residual polymer **after** the electrically conductive interconnect line is contacted with the liquid water. Muranaka relates to a method for removing resist residue. Muranaka indicates

there are five embodiments of their invention. As will be shown below, the first three embodiments of Muranaka clearly do not teach or fairly suggest the limitations of independent claim 1 set forth above, either alone or in combination with the remaining limitations of independent claim 1.

The first embodiment for removing resist residue requires (1) a removal fluid processing step, (2) a rinsing step, (3) a draining step, (4) a water-washing step, and (5) a spin-drying step. Steps (1) – (5) are performed in order. See Muranaka 3:22-27. Importantly, Muranaka does not indicate that any of steps (2) through (5) recite contacting the electrically conductive interconnect line with a solution to remove residual polymer. Step (1) of the first embodiment can be seen as teaching claim 1's act of contacting the electrically conductive interconnect line with a solution to remove residual polymer. However, the first embodiment of Muranaka fails to teach or fairly suggest that step (1) occurs **after** the electrically conductive interconnect line is contacted with the liquid water. Rather, Muranaka specifically states that the removal fluid processing step (1) is performed **before** water-washing step (4). For these reasons, the first embodiment of Muranaka fails to teach or fairly suggest claim 1.

The second embodiment of Muranaka is described in 4:10-22. Muranaka's second embodiment is employed in an apparatus slightly different than the apparatus in which the Muranaka's first embodiment is employed. Muranaka states, "The resist residue removal step is identical with that in the first embodiment, and hence its explanation is omitted." Muranaka 4:21-22. Applicant reads Muranaka's second embodiment as performing the same steps set forth in the first embodiment and in the same order, but in a different apparatus. For these reasons and the reasons made above with respect to Muranaka's first embodiment, the second embodiment of Muranaka fails to teach or fairly suggest claim 1.

The third embodiment of Muranaka is described in column 4:24-64. This embodiment is carried out in sequence of (1) a removal fluid processing step, (2) a washing step, and (3) a drying step. Muranaka 4:45-47 Muranaka does not indicate steps (2) and (3) of the third embodiment recite contacting the electrically conductive interconnect line with a solution to remove residual polymer. Presuming step (1) of the second embodiment is the same as claim 1's requirement of contacting the electrically conductive interconnect line with a solution to remove residual polymer, the third embodiment of Muranaka fails to teach or fairly suggest that step (1) occurs **after** the electrically conductive interconnect line is contacted with the liquid water. Rather, the removal fluid processing step (1) of Muranaka's third embodiment is performed **before** their washing step (2). Even if the washing step (2) of the third embodiment employs water, the first embodiment of Muranaka fails to teach or fairly suggest claim 1.

The first three embodiments of Muranaka fail to teach or fairly suggest claim 1. As noted above, Muranaka describes fourth and fifth embodiments. The Final Office Action asserts that Muranaka's fourth embodiment discloses all the limitations of independent claim 1. Applicants note that a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. Importantly, the elements must be arranged as required by the claim. See MPEP 2131.

Muranaka describes the fourth embodiment in 4:65 - 5:17. Specifically, the fourth embodiment is directed to a rinsing method and/or a washing method for removing resist residue and is characterized in that a fluid used for rinsing or washing (e.g., ultrapure water, a fluid specifically designed for rinsing purpose, or a combination thereof) is maintained at a temperature of 20 degrees C or less. Muranaka then states:

In order to improve the efficiency of substitution of the residual removal fluid during the rinsing operation, the supply of rinsing fluid is increased to a large value of 0.5 liter/min per wafer, and the semiconductor wafer is rinsed within a short time period of three minutes or less. As a result, the time during which aluminum reacts in the rinsing operation can be shortened, and sufficient substitution of the residual removal fluid can be effected.

In the fourth embodiment, a sufficient effect can be yielded by carrying out solely the above-described operations. Through combination of the apparatus and methods described with reference to the first through third embodiments, a further improvement in resist residue removal characteristics can be expected.

Muranaka 5:6 -5:20.

The description of Muranaka's fourth embodiment is vague at best. Muranaka 4:65 - 5:17 describes "substitution of the residual removal fluid." One of ordinary skill in the art might interpret "substitution of the residual removal fluid" to mean that the removal fluid processing step (1) of the first embodiment is replaced with rinsing or washing with a fluid (e.g., ultrapure water, a fluid specifically designed for rinsing purpose, or a combination thereof) maintained at a temperature of 20 degrees C or less. With this interpretation, the fourth embodiment is carried out in sequence of (1) a step of rinsing or washing with a fluid (e.g., ultrapure water, a fluid specifically designed for rinsing purpose, or a combination thereof) maintained at a temperature of 20 degrees C or less, (2) a rinsing step, (3) a draining step, (4) a water-washing step, and (5) a spin-drying step. Presuming step (1) of the fourth embodiment is the same as claim 1's requirement of contacting the electrically conductive interconnect line with a solution to remove residual polymer, the fourth embodiment of Muranaka fails to teach or fairly suggest that step (1) occurs **after** the electrically conductive interconnect line is contacted with the liquid water.

Rather, the rinsing or washing with a fluid (e.g., ultrapure water, a fluid specifically designed for rinsing purpose, or a combination thereof) maintained at a temperature of 20 degrees C or less of step (1) of the fourth embodiment is performed **before** Muranaka's water-washing step (4).

Muranaka describes in 5:15-17, "In the fourth embodiment, a sufficient effect can be yielded by carrying out **solely** the above-described operations," i.e., rinsing or washing with a fluid (e.g., ultrapure water, a fluid specifically designed for rinsing purpose, or a combination thereof) maintained at a temperature of 20 degrees C or less. Muranaka's **sole** act of rinsing or washing with a fluid (e.g., ultrapure water, a fluid specifically designed for rinsing purpose, or a combination thereof) maintained at a temperature of 20 degrees C or less, without more, cannot anticipate claim 1 since claim 1 specifically requires **two** acts: (a) contacting the electrically conductive interconnect line with liquid water after formation of the electrically conductive interconnect line, and (b) contacting the electrically conductive interconnect line with a solution to remove residual polymer after the electrically conductive interconnect line is contacted with the liquid water.

Muranaka also states in 5:17-20, "Through combination of the apparatus and methods described with reference to the first through third embodiments, a further improvement in resist residue removal characteristics can be expected." Contrary to the assertion in the Office Action at page 9: 5-7 this section does not state through combination of the apparatus and methods described with reference to the first through **fourth** embodiments, a further improvement in resist residue removal characteristics can be expected. Applicant cannot agree with the Examiner that the mere mention of "or a combination thereof" in the fourth embodiment, infers that the fourth embodiment enables an ultrapure water step followed by a rinse step with the fluid specifically designed for rinsing purpose. Because Applicant has shown that embodiments 1 – 3

do not teach or suggest claim 1, Applicant asserts that no “combination of the apparatus and methods described with reference to the first through third embodiments” can be said to anticipate claim 1. If anything, Muranaka’s suggestion of combining the first three embodiments amounts to a sixth embodiment. For these reasons, the fourth embodiment of Muranaka fails to teach or fairly suggest claim 1.

Muranaka describes the fifth embodiment of his invention as being directed to a method which includes a draining step for the purpose of removing resist residue. Muranaka 5:23-25. After completion of the removal fluid processing step, the semiconductor is rotated at high speed before the washing step is commenced, thereby eliminating the removal fluid from the semiconductor wafer. Muranaka 5:25-29. The fifth embodiment of Muranaka fails to teach or fairly suggest claim 1’s requirement of contacting the electrically conductive interconnect line with a solution to remove residual polymer **after** the electrically conductive interconnect line is contacted with the liquid.

Independent claim 32, like independent claim 1, recites contacting the electrically conductive interconnect line with liquid water followed by contacting the electrically conductive interconnect line with a solution to remove residual polymer. Applicant submits independent claim 32 is patentably distinguishable over Muranaka for the same reasons claim 1 is patentably distinguishable.

Claims 5-9 depend from independent claim 1. Claims 33 – 37 depend from independent claim 32. Insofar as independent claims 1 and 32 have been shown to be patentably distinguishable over Muranaka, Applicants submit that dependent claims 5-9, and 33-37 are likewise patentably distinguishable.

Independent claim 27, like independent claim 1 and independent claim 32, recite contacting the electrically conductive interconnect line with liquid water followed by contacting the electrically conductive interconnect line with the solution to remove residual polymer. For reasons set forth above, Applicant submits that independent claim 27 is patentably distinguishable over Muranaka in view of Wang. Moreover, for reasons set forth above, Applicant submits that dependent claims 28-31 are likewise patentably distinguishable over the combination of Muranaka and Wang, since dependent claims 28-31 depend from independent claim 27.

All claims stand rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 5,476,816 issued to Karl E. Mautz (“Mautz”) in view of U.S. Patent 6,410,417 issued to Nien-Yu Tsai et al. (“Tsai”) and further in view of page two, paragraph nine, through page 3, paragraph 11 of the instant application. The Office Action asserts that page 2, paragraph nine through page 3, paragraph 11 of the instant application is admitted prior art. For purposes of this response only, Applicant will presume that page two, paragraph 9 through page 3, paragraph 11 is prior art.

Each of independent claims 1, 27, and 32 recite “wherein the electrically conductive interconnect line is contacted with the liquid water for less than 120 minutes.” In rejecting all claims as being unpatentable over Mautz in view of Tsai, the Office Action asserts on page 6 that Mautz teaches “wherein the electrically conductive interconnect line is contacted with the liquid water for less than 120 minutes” citing Mautz claim 1; 4:2-27, 5:30-35, 6:2-4, 6:28-29, 6:45-61, 7:2-17 in support thereof. Applicants have reviewed these cited sections of Mautz and can find no teaching or fair suggestion of the independent claims’ limitation “wherein the electrically conductive interconnect line is contacted with the liquid water for less than 120 minutes” either

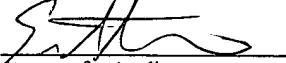
alone or in combination with the other limitations of the independent claims. At least one of these cited sections teaches “solvent rinse time,” but solvent rinse time is different than water rinse time. See Mautz 6:45-47.

The limitation “wherein the electrically conductive interconnect line is contacted with the liquid water for less than 120 minutes” is time specific. While Mautz may teach contacting the electrically conductive interconnect line with liquid water after formation of the electrically conductive line, Mautz is silent about the amount of time his electrically conductive interconnect line is contacted with liquid water. As such, all claims are patentably distinguishable over the combination of Mautz and Tsai.

CONCLUSION

Applicants submit that all claims are now in condition for allowance, and an early notice to that effect is earnestly solicited. Nonetheless, should any issues remain that might be subject to resolution through a telephonic interview, the Examiner is requested to telephone the undersigned.

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Mail Stop AF, Commissioner for Patents, P. O. Box 1450, Alexandria, Virginia, 22313-1450, on April 28, 2006.


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4/28/06
Date of Signature

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